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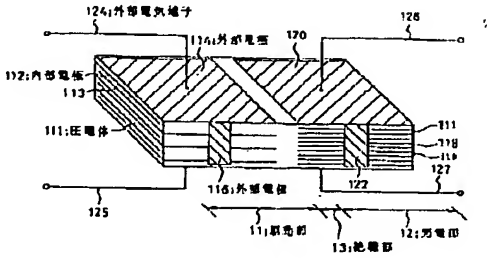
(54) LAMINATED-TYPE PIEZOELECTRIC TRANSFORMER

(57) Abstract:

PROBLEM TO BE SOLVED: To provide a safe piezoelectric transformer, provided with high conversion efficiency for easily matched impedance and separating input and output by turning a drive part and a power generation part into constitution such that a piezoelectric body and an internal electrode are alternately laminated and an insulation part is provided between them in a laminated (step-down) type piezoelectric transformer.

SOLUTION: In a laminated (step-down)-type piezoelectric transformer element composed of a drive part 11 and the power generation part 12 for which a piezoelectric body 111 polarized in a thickness direction and internal electrodes 112, 113, 118 and 119 are laminated for a plurality of on-both end sides of the length direction of the piezoelectric body in a long plate shape and external electrodes 114, 116, 120 and 122, the thickness of the piezoelectric body 111 of the drive part 11 is made larger than the thickness of the piezoelectric body 111 of the power generation part 12.



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(54) **LAMINATED-TYPE PIEZOELECTRIC TRANSFORMER**

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PROBLEM TO BE SOLVED: To provide a safe piezoelectric transformer, provided with high conversion efficiency for easily matched impedance and separating input and output by turning a drive part and a power generation part into constitution such that a piezoelectric body and an internal electrode are alternately laminated and an insulation part is provided between them in a laminated (step-down) type piezoelectric transformer.
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CLAIMS

[Claim(s)]
[Claim 1] The laminating mold piezoelectric transformer characterized by the thing with much more thickness of the piezo electric crystal of said mechanical component thicker than much more thickness of the piezo electric crystal of said generation-of-electrical-energy section in the piezoelectric transformer which has arranged the mechanical component and the generation-of-electrical-energy section to which the laminating of the piezo electric crystal by which polarization was carried out in the thickness direction at the both-ends side of the die-length direction of a long tabular piezoelectric transformer, and the internal electrode was carried out by turns, and has arranged the insulating section into the part pinched in said mechanical component and said generation-of-electrical-energy section.
[Claim 2] The laminating mold piezoelectric transformer characterized by what said mechanical component and said generation-of-electrical-energy section dissociate, and are arranged in a laminating mold piezoelectric transformer according to claim 1 in one half of the locations of the wavelength lambda of machine resonance of the longitudinal oscillation of the die-length direction of said long tabular piezoelectric transformer, and is driven by one half of the twice as many oscillation modes of said wavelength lambda as this.
[Claim 3] The laminating mold piezoelectric transformer characterized by using a laminating mold piezoelectric transformer according to claim 1 or 2 as a pressure-lowering transformer.
[Claim 4] For thickness with the piezo electric crystal of said generation-of-electrical-energy section much more in the piezoelectric transformer which has arranged the insulating section into the part which has arranged the mechanical component and the generation-of-electrical-energy section to which the laminating of the piezo electric crystal by which polarization was carried out in the thickness direction at the both-ends side of the die-length direction of a long tabular piezoelectric transformer, and the internal electrode was carried out by turns, and was pinched in said mechanical component and said generation-of-electrical-energy section, much more thickness of the piezo electric crystal of said mechanical component is the laminating mold piezoelectric transformer with which it is characterized by what is differed.

[Claim 5] The laminating mold piezoelectric transformer characterized by what said mechanical component and said generation-of-electrical-energy section dissociate, and are arranged in a laminating mold piezoelectric transformer according to claim 4 in the location of wavelength lambda / 2 of machine resonance of the longitudinal oscillation of the die-length direction of said long tabular piezoelectric transformer, and is driven by said twice as many oscillation mode of wavelength lambda / 2 as this.
[Claim 6] The laminating mold piezoelectric transformer characterized by using a laminating mold piezoelectric transformer according to claim 4 or 5 as a pressure-up transformer.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the laminating pressure-lowering mold thru/or pressure-up mold piezoelectric transformer which uses for the small rectification power source as which a miniaturization, lightweight-izing, and high-reliability are required especially about the

transformer used for various kinds of DC power supplies, and is made suitable.

[0002]
[Description of the Prior Art]the so-called pressure-lowering mold transformer of the AC adapter which supplies a power source to various kinds of cell drive type electronic equipment from a source-power-supply line conventionally -- the electromagnetism of a coil mold -- the transformer has been used. this electromagnetism -- the structure where a transformer twists lead wire around the core of the magnetic substance -- becoming -- **** -- small and lightweight electromagnetism -- it was very difficult to realize a transformer.
[0003]on the other hand, electromagnetism -- the piezoelectric transformer with which the principle of operation completely differs from a transformer is proposed by 1958R.A.ROSEN (refer to U.S. Pat. No. 2,830,274 specification). The typical example of structure of this is shown in drawing 2 (the piezoelectric transformer is driving in the lambda/2 mode).
[0004]With reference to drawing 2, polarization of the part which formed the plane electrodes 202 and 203 in the piezo electric crystal 201 top and the inferior surface of tongue is carried out in the thickness direction by the mechanical component 21. Moreover, polarization of the part pinched by the end-face electrode 204 prepared in the edge of a piezo electric crystal 201 and the mechanical component 21 is carried out in the die-length direction in the generation-of-electrical-energy section 22.
[0005]This piezoelectric transformer equips the joint at the time of resonance of the longitudinal oscillation of the die-length direction with support 205, and fixes it to a base material (not shown). Impression of the alternating voltage which has the resonance frequency of the longitudinal oscillation of the die-length direction of a piezo electric crystal 201 in this condition through the external electric terminals 206 and 207 linked to the plane electrodes 202 and 203 generates an electrical potential difference between the external electric terminal 207 and the external electric terminal 208 linked to the end-face electrode 204.
[0006]By the way, in the piezoelectric transformer shown in drawing 2, since the connecting location of an external electric terminal was not the joint of vibration, a mechanical component and the generation-of-electrical-energy section had the problem that effectiveness and dependability fell. Moreover, since this piezoelectric transformer was a veneer, the pressure-up ratio also had the problem that it could not do sufficiently greatly.
[0007]The laminating mold piezoelectric transformer proposed by JP,6-224484,A as a conventional technique which meant aiming at an improvement of these problems is known. Drawing 3 is the sectional view showing the configuration of this conventional laminating mold piezoelectric transformer. This laminating mold piezoelectric transformer is driven by lambda/2 of the drive frequencies in the 3 time mode.
[0008]With reference to drawing 3, in the piezo-electric rectangle-like plate 310, the part shown by 31 is the mechanical component of low impedance, two or more layer laminating of plane internal electrodes 311 and 312 and piezo electric crystal 313 is carried out by turns, the plane electrodes 314 and 315 are formed on the surface of the upper and lower sides, and the external electrode (not shown) is formed on the side face as an object for connection of an internal electrode with this laminating mold piezoelectric transformer. And polarization of these parts is carried out in the thickness direction.
[0009]Moreover, similarly, the part shown by 32 is the generation-of-electrical-energy section of a high impedance, two or more layer laminating of strip-of-paper-like an internal electrode 317 and a piezo electric crystal 313 is carried out by turns, the strip-of-paper-like electrodes 318 and 319 are formed on the surface of the upper and lower sides, and the external electrode (not shown) is formed on the side face as an object for connection of an internal electrode.
[0010]And polarization of the generation-of-electrical-energy section is carried

out in the die-length direction. The fall of effectiveness and dependability which were described above does not take place from the ability of this piezoelectric transformer to connect the external electric terminals 321, 322, and 323 in the joint of the longitudinal oscillation of the die-length direction, respectively, and since it is a laminating mold, a large pressure-up ratio can also be taken.

[0011]By the way, they are the things of a pressure-up mold, and there are problems, such as impedance matching and conversion efficiency, and no above-mentioned piezoelectric transformers are practical, when these I/O is made reverse and used for a pressure-lowering mold.

[0012]On the other hand, there are some which are proposed by JP,8-153914,A, JP,6-177451,A, and JP,5-235432,A as a piezoelectric transformer of a pressure-lowering mold.

[0013]The configuration of the piezoelectric transformer of the pressure-lowering mold first proposed by above-mentioned JP,8-153914,A is shown in drawing 4. In drawing 4, the part shown by 41 is a mechanical component, two or more layer laminating of internal electrodes 401 and 402 and the piezo electric crystal 403 is carried out by turns, and each internal electrode is electrically connected through the external electric terminal (not shown). And polarization of these parts is carried out in the thickness direction.

[0014]Moreover, the part shown by 42 is the generation-of-electrical-energy section, two or more layer laminating of internal electrodes 406 and 407 and the piezo electric crystal 408 is carried out by turns, and each internal electrode is electrically connected through the external electric terminal (not shown). This piezoelectric transformer is interlocked with vibration of the die-length direction of a mechanical component, generates vibration of the die-length direction of the generation-of-electrical-energy section, generates the electrical potential difference whose pressure was lowered, through the external electric terminals 404 and 405, impresses the alternating voltage of the primary resonance frequency of the die-length direction to a mechanical component 41, and generates the electrical potential difference whose pressure was lowered by the generation-of-electrical-energy section 42 through the external electric terminals 409 and 410.

[0015]Next, the configuration of the piezoelectric transformer of the pressure-lowering mold proposed by above-mentioned JP,6-177451,A is shown in drawing 5. In drawing 5, it is the generation-of-electrical-energy section, and the part shown by 51 forms the plane electrodes 501 and 502 in the vertical side of the die-length direction, and polarization is carried out in the thickness direction. Moreover, it is a mechanical component, and the part shown by 52 forms an input electrode 503 in the side face of the die-length direction, and polarization is carried out crosswise among the flat-surface top electrodes 501 and 502 of a mechanical component. This piezoelectric transformer is a thing using the longitudinal-oscillation transversal effect, impresses the alternating voltage of the primary resonance frequency of the die-length direction through the external electric terminals 504 and 505, and generates the electrical potential difference whose pressure was lowered by the generation-of-electrical-energy section 51 through the external electric terminals 505 and 506.

[0016]Finally, the configuration of the piezoelectric transformer of the pressure-lowering mold proposed by above-mentioned JP,5-235432,A is shown in drawing 6. In drawing 6, the part shown by 61 is a mechanical component, the laminating of internal electrodes 601 and 602 and the piezo electric crystal 603 is carried out, and each internal electrode is electrically connected through the external electric terminal (not shown). And polarization of these parts is carried out in the thickness direction.

[0017]Moreover, the part shown by 62 is the generation-of-electrical-energy section, two or more layer laminating of internal electrodes 606 and 607 and the piezo electric crystal 608 is carried out by turns, and each internal electrode is electrically connected through the external electric terminal (not shown). And

polarization also of these parts is carried out in the thickness direction. This piezoelectric transformer is interlocked with the longitudinal oscillation of the thickness direction of a mechanical component, generates vibration of the thickness direction of the generation-of-electrical-energy section, generates the electrical potential difference whose pressure was lowered, through the external electric terminals 604 and 605, impresses the alternating voltage of the 3rd resonance frequency of the thickness direction to a mechanical component 61, and generates the electrical potential difference whose pressure was lowered by the generation-of-electrical-energy section 62 through the external electric terminals 609 and 610.

[0018]

[Problem(s) to be Solved by the Invention]However, the above-mentioned conventional technique has the trouble of the following publication, respectively.

[0019](1) Although each piezoelectric transformer proposed by the conventional piezoelectric transformer (refer to U.S. Pat. No. 2,830,274 specification) and conventional above-mentioned JP,6-224484,A of a ROSEN mold as the 1st trouble is the thing of a pressure-up mold, and it will become theoretic in a pressure-lowering mold if I/O is made reverse, it has a problem in respect of impedance matching and conversion efficiency, and there is no **** in practical use.

[0020](2) If it is proposed by above-mentioned JP,8-153914,A among the piezoelectric transformers of a pressure-lowering mold and a piezoelectric transformer is explained as the 2nd trouble, this will be interlocked with vibration of the die-length direction of a mechanical component, will generate vibration of the die-length direction of the generation-of-electrical-energy section, and will use the primary oscillation mode of the die-length direction. For this reason, there is a problem that it is difficult to hold a piezoelectric transformer at the node point of vibration, and it is sufficiently highly impossible. [of conversion efficiency]

[0021](3) If the piezoelectric transformer proposed by above-mentioned JP,6-177451,A is explained as the 3rd trouble, this is what used the longitudinal-oscillation transversal effect, and is a veneer mold, and has taken the ground of I/O in common. For this reason, it is hard to take the variation of impedance matching to a load, and since the ground of I/O is common, there is also a problem on insurance.

[0022](4) When the piezoelectric transformer proposed by above-mentioned JP,5-235432,A is explained as the 4th trouble, this is a thing using thickness longitudinal oscillation, since drive frequency is too as high as 2.4MHz, has a point difficult for a drive circuit, and has a problem in respect of utilization.

[0023]Therefore, this invention is make that the above-mentioned conventional trouble should be cancel, it is make it the configuration which holds a piezoelectric transformer at a node point, can make conversion efficiency sufficiently high, can take impedance matching easily by the lamination of a laminating, further, is the configuration of having separate a mechanical component and the generation of electrical energy section, and aims at offer the laminating (pressure lowering thru/or pressure up) mold piezoelectric transformer in which an insurance top does not have a problem, either.

[0024]

[Means for Solving the Problem]In order to attain said purpose, the laminating mold piezoelectric transformer by the 1st view of the invention in this applicationIn the piezoelectric transformer which has arranged the mechanical component and the generation-of-electrical-energy section to which the laminating of the piezo electric crystal by which polarization was carried out in the thickness direction at the both-ends side of the die-length direction of a long tabular piezoelectric transformer, and the internal electrode was carried out by turns, and has arranged the insulating section into the part pinched in said

mechanical component and said generation-of-electrical-energy sectionIt is characterized by the thing with much more thickness of the piezo electric crystal of said mechanical component thicker than much more thickness of the piezo electric crystal of said generation-of-electrical-energy section.

[0025]Moreover, in the 1st invention of the above, said mechanical component and said generation-of-electrical-energy section dissociate, and are arranged in one half of the locations of the wavelength lambda of machine resonance of the longitudinal oscillation of the die-length direction of said long tabular piezoelectric transformer, and the laminating mold piezoelectric transformer by the 2nd view of the invention in this application is characterized by what is driven by one half of the twice as many oscillation modes of said wavelength lambda as this.
[0026]Furthermore, this invention offers not only a pressure-lowering mold but the laminating mold piezoelectric transformer of a pressure-up mold (the 4th view) as the 3rd view.
[0027]As the 5th view, the laminating mold piezoelectric transformer by the comprehensive view of the invention in this applicationIn the piezoelectric transformer which has arranged the mechanical component and the generation-of-electrical-energy section to which the laminating of the piezo electric crystal by which polarization was carried out in the thickness direction at the both-ends side of the die-length direction of a long tabular piezoelectric transformer, and the internal electrode was carried out by turns, and has arranged the insulating section into the part pinched in said mechanical component and said generation-of-electrical-energy sectionMuch more thickness of the piezo electric crystal of said mechanical component is characterized by what is differed from much more thickness of the piezo electric crystal of said generation-of-electrical-energy section.
[0028]Moreover, in the 6th view of the above, said mechanical component and said generation-of-electrical-energy section dissociate, and are arranged in the location of wavelength lambda / 2 of machine resonance of the longitudinal oscillation of the die-length direction of said long tabular piezoelectric transformer, and the laminating mold piezoelectric transformer of the 5th view of this application is characterized by what is driven by said twice as many oscillation mode of wavelength lambda / 2 as this.
[0029]
[Embodiment of the Invention]The gestalt of operation of this invention is explained below. The laminating mold piezoelectric transformer of this invention is set in the gestalt of the desirable operation. The mechanical component (11 of drawing 1) and the generation-of-electrical-energy section (12 of drawing 1) by which the laminating of the piezo electric crystal by which polarization was carried out in the thickness direction, and the internal electrode was carried out by turns to the both-ends side of the die-length direction of a long tabular piezoelectric transformer are arranged. In the piezoelectric transformer which has arranged the insulating section (13 of drawing 1) into the part pinched by the above-mentioned mechanical component and the generation-of-electrical-energy section, it is characterized by much more thickness of the piezo electric crystal of the above-mentioned mechanical component (11 of drawing 1) being thicker than much more thickness of the piezo electric crystal of the above-mentioned generation-of-electrical-energy section.
[0030]And in the gestalt of operation of this invention, the above-mentioned mechanical component and the generation-of-electrical-energy section dissociate, are arranged in the location of the wavelength 1/2lambda of machine resonance of the longitudinal oscillation of the die-length direction of the above-mentioned long tabular piezoelectric transformer, and drive by the twice as many oscillation mode as the above-mentioned wavelength 1/2lambda.
[0031]If an operation of the gestalt of operation of this invention is explained, as described above, it will set to this invention. Each by the side of the both ends of a long tabular piezoelectric transformer is considered as the

configuration which carried out two or more layer laminating of an internal electrode and the piezo electric crystal as a mechanical component and the generation-of-electrical-energy section. In the boundary of a mechanical component and the generation-of-electrical-energy sectionSince it is the configuration whichwas [low-impedance-] easy toize according to the impedance of a load, and carried out insulating separation of a mechanical component and the generation-of-electrical-energy section by preparing the insulating section, making it drive in the secondary mode of the die-length direction further, and changing a laminating configuration, there is also no problem in the point of safety. And since maintenance of a piezoelectric transformer can be performed at the node point of vibration, the operation effectiveness that conversion efficiency can also be made high is done so.

[0032]

[Example]The gestalt of operation of above-mentioned this invention is explained below with reference to a drawing about the example of this invention that it should explain to a detail further.

[0033]Drawing 1 is the perspective view showing the configuration of the 1st example of this invention. With reference to drawing 1, the part shown by 11 is the mechanical component of a high impedance of a piezoelectric transformer, two or more sheet laminating of a piezo electric crystal 111 and the internal electrodes 112 and 113 is carried out by turns, and it has the external electrode formed in the vertical side, and by drawing 1, only the external electrode 114 on top is shown and the external electrode prepared in the inferior surface of tongue of this and the opposite side is not illustrated.

[0034]Moreover, the external electrode 116 prepared in the flank and the external electrode (not shown) prepared in this flank and the flank of the opposite side which counters are external electrodes which connect electrically the internal electrodes 112 and 113 exposed on the side face which counters for setting further, respectively. And polarization of inter-electrode [these] is carried out in the thickness direction.

[0035]Moreover, the part shown by 12 is the generation-of-electrical-energy section of low impedance, two or more sheet laminating of a piezo electric crystal 111 and the internal electrodes 118 and 119 is carried out by turns, and it has the external electrode formed in the vertical side, and in drawing 1, only the external electrode 120 on top is shown and the external electrode prepared in the inferior surface of tongue of this and the opposite side is not illustrated.

[0036]Moreover, the external electrode 122 prepared in the flank and the external electrode (not shown) prepared in this flank and the flank of the opposite side which counters are external electrodes which connect electrically the internal electrodes 118 and 119 exposed on the side face which counters for setting further, respectively. And polarization of inter-electrode [these] is carried out in the thickness direction.

[0037]And the insulating section 13 is formed between a mechanical component 11 and the generation-of-electrical-energy section 12.

[0038]If the piezoelectric transformer of this example makes alternating voltage input and drive between the external electric terminal 124 linked to the electrode of a mechanical component 11, and 125, an electrical potential difference will output it between the external electric terminal 126 linked to the electrode of the generation-of-electrical-energy section 12, and 127.

[0039]Next, the manufacture approach of the piezoelectric transformer of this example of an operation form is explained.

[0040]In this example, the piezoelectric transformer produced the piezoelectric transformer of a configuration of having been shown in drawing 1 by the green sheet method. NEPEKKU 8 (Tokin Corp. make) was used for the ingredient of a piezo electric crystal 111.

[0041]Moreover, using the baking type Ag/Pd paste (the presentation ratio of Ag/Pd is 70/30 at a weight ratio), on the green sheet of a piezo electric crystal

111, after screen-stenciling internal electrodes 112, 113, 118, and 119 by the predetermined pattern, the laminating of them was carried out, and they were formed by really calcinating with a piezo electric crystal 111 on the conditions of temperature, 1200 degrees C, and 2 keeping time amount and hours.
[0042]At this example, although PZT system electrostrictive ceramics and Ag/Pd were used as an ingredient of a piezo electric crystal and an internal electrode, if it is the piezoelectric material and this which have piezoelectric, and the electrode material which can really be calcinated, it cannot be overemphasized that it operates in other combination.
[0043]As a configuration of a laminating, about a mechanical component 11, it is seven layers of piezo electric crystals, and six layers of internal electrodes, the thickness between internal electrodes is 285 micrometers, it is 35 layers of piezo electric crystals, and 34 layers of internal electrodes about the generation-of-electrical-energy section 12, and the thickness between internal electrodes is 57 micrometers.
[0044]Next, the external electrodes 114, 115, 116, 117, 120, 121, 122, and 123 were formed by processing die length of 48mm, width of face of 15mm, and a dimension with a thickness of 2mm after baking, and calcinating a baking type Ag/Pd paste on the conditions of temperature, 700 degrees C, and 15 keeping time amount and minutes after printing to the position of the vertical side of a mechanical component 11, a side face and the vertical side of the generation-of-electrical-energy section 12, and a side face.
[0045]Next, using the polarization fixture, 2-3kV /of electric fields was impressed mm into silicone oil with a temperature of 100-200 degrees C, and a mechanical component 11 and the generation-of-electrical-energy section 12 were polarized, respectively.
[0046]When the electrical potential difference was impressed by 70kHz of drive frequencies, having used 10 ohms as the load for the piezoelectric transformer obtained as a result, it drove in the secondary mode of resonance of the die-length direction and the transformer property was evaluated, in output power 20-30W, conversion efficiency was 98.5% and the transformation ratio was 0.252.

[0047]On the other hand, in the **** conventional example (based on JP,6-177,A and No. 451) shown in Fig. 5 of this application, it is output power 16-32W, and conversion efficiency is 91 - 95%, and transformation ratios are 0.16-0.15.

[0048]Consequently, it turns out that the piezoelectric transformer of this example excels the conventional thing in conversion efficiency.

[0049]Moreover, in the case of this example, about a transformation ratio, it can set up at any cost by not being based on pressure lowering and a pressure up, but adjusting the laminating configuration of a mechanical component and the generation-of-electrical-energy section. For this reason, comparing with the conventional technique is meaningless.
[0050]Next, the 2nd example of this invention is explained. Since the point that the 2nd example of this invention is different from the 1st example of the above is the laminating configuration and dimension of a mechanical component and the generation-of-electrical-energy section of a piezoelectric transformer, it explains only this point.
[0051]The piezoelectric transformers of the 2nd example of this invention are eight layers of piezo electric crystals, and seven layers of internal electrodes about a mechanical component 11 as a laminating configuration, the thickness between internal electrodes is 500 micrometers, it is 48 layers of piezo electric crystals, and 47 layers of internal electrodes about the generation-of-electrical-energy section 12, and the thickness between internal electrodes is 83 micrometers.
[0052]And a dimension is 4mm in die length of 48mm, width of face of 15mm, and thickness.
[0053]When the electrical potential difference was impressed by 70kHz of drive

frequencies, having used 10 ohms as the load for the piezoelectric transformer obtained as a result, it drove in the secondary mode of resonance of the die-length direction and the transformer property was evaluated, in output power 30-40W, conversion efficiency was 98.3% and the transformation ratio was 0.167.

[0054]Conversion efficiency was able to make the transformation ratio small not changeful by having differed the laminated structure of a mechanical component and the generation-of-electrical-energy section from said 1st example. From this result, by adjusting a laminating configuration, while it has been efficient, a transformation ratio can be adjusted.
[0055]In addition, although the 1st and 2nd example explained the pressure-lowering mold, by making relation between an input and an output reverse, this invention can be similarly carried out as a pressure-up mold, and has the same effectiveness.
[0056]
[Effect of the Invention]As explained above, according to this invention, the configuration of a mechanical component and the generation-of-electrical-energy section with the configuration which carried out two or more layer laminating of a piezo electric crystal and the internal electrode by turnsBy considering as the configuration which prepared the insulating section between a mechanical component and the generation-of-electrical-energy section, and driving in the secondary mode of resonance of the die-length directionA piezoelectric transformer can be held at a node point, conversion efficiency can be made sufficiently high, and impedance matching can be easily taken with the laminating configuration of a mechanical component and the generation-of-electrical-energy section, and the effectiveness that a transformation ratio can also be adjusted freely is done so.
[0057]Furthermore, according to this invention, the effectiveness that an insurance top is also satisfactory is done so with the configuration of having separated I/O.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is the perspective view showing the configuration of the laminating mold piezoelectric transformer of one example of this invention.
[Drawing 2]It is the perspective view showing the configuration of the conventional veneer mold piezoelectric transformer.
[Drawing 3]It is the sectional view showing the configuration of the conventional laminating mold piezoelectric transformer.
[Drawing 4]It is the sectional view showing the conventional pressure-lowering mold piezoelectric transformer.
[Drawing 5]It is the perspective view showing the conventional pressure-lowering mold piezoelectric transformer.
[Drawing 6]It is the perspective view showing the conventional pressure-lowering mold piezoelectric transformer.
[Description of Notations]
11, 21, 31, 41, 51, 61 Mechanical component
12, 22, 32, 42, 52, 62 Generation-of-electrical-energy section
13 Insulating Section
111, 201, 313, 403, 408, 603, 608 Piezo electric crystal
310 Piezo-electric Board
112, 113, 118, 119, 311, 312, 401, 402, 406, 407, 601, 602, 606, 607 Internal electrode
114, 115, 120, 121 External electrode
116, 117, 122, 123, 316, 320 External electrode (for internal electrode connection)

202, 203, 314, 315, 501, 502 Plane electrode
204 End-Face Electrode
205 Support
317 Strip-of-Paper-like Internal Electrode
318 319 Strip-of-paper-like electrode
503 Input Electrode
124, 125, 126, 127, 206, 207, 208, 321, 322, 323, 404, 405, 409, 410, 504, 505, 506, 604, 605, 609, 610 External electric terminal

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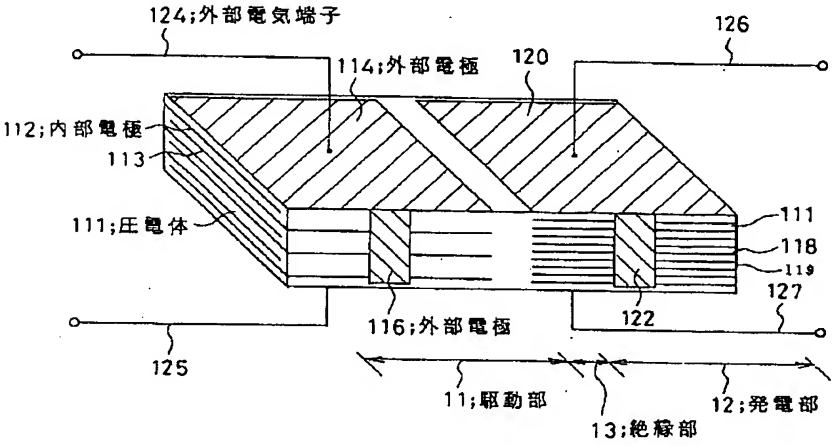
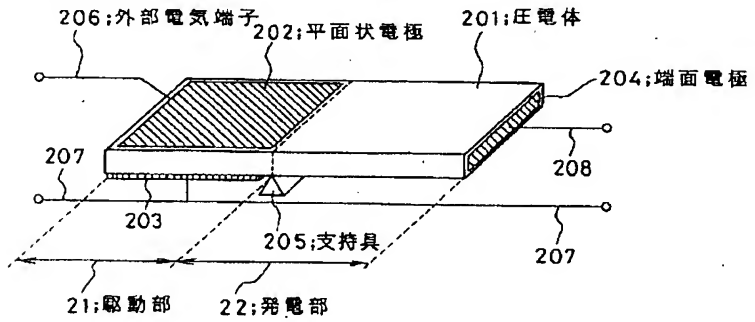
DRAWINGS

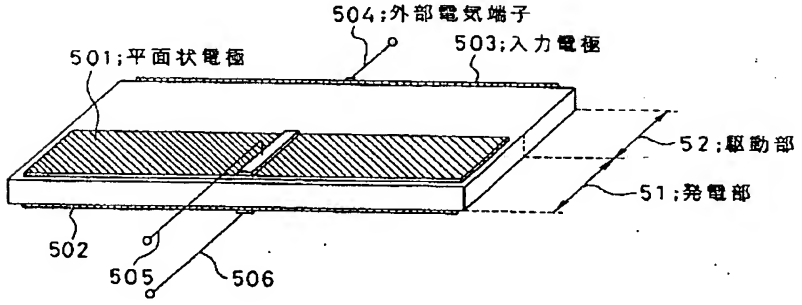
[Drawing 1]



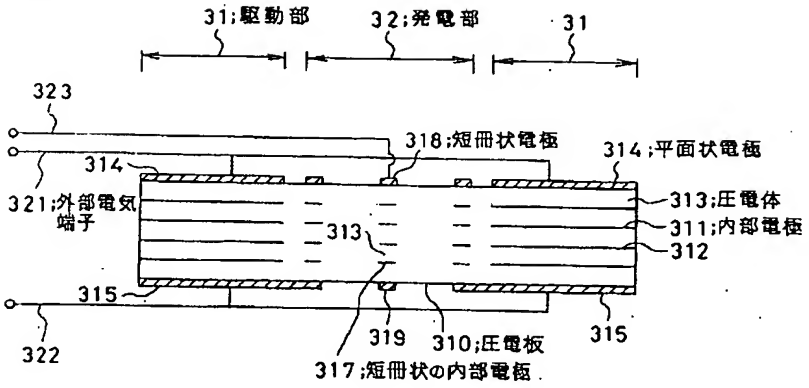
[Drawing 2]



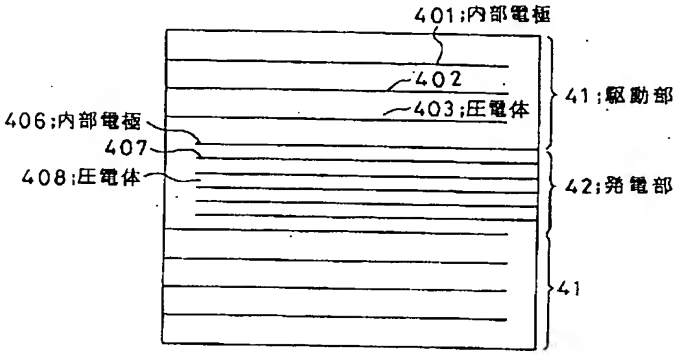
[Drawing 5]



[Drawing 3]



[Drawing 4]



[Drawing 6]